JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2024

B. Tech. -III Semester (CSE-AI&ML, AI&DS)

COURSE CODE (CREDITS): 24B11CI311(3) MAX. MARKS: 35

COURSE NAME: Computational Fundamentals for Optimization

COURSE INSTRUCTORS: SST MAX. TIME: 2 Hours

***Note:*** *(a) All questions are compulsory.*

*(b) The candidate is allowed to make suitable numeric assumptions wherever required for solving problems.*

*(c) Use of a scientific calculator is allowed.*



| Q. No | Question | CO | Marks |
|---|---|---|---|
| **Q1** | **(a)** Classify the matrix $\begin{bmatrix} 3 & 1 & 2 \\ 1 & -1 & 3 \\ 2 & 3 & 2 \end{bmatrix}$ as positive definite, negative definite, or indefinite matrix.<br><br>**(b)** Let $M_{n\times n}$ be the vector space of n × n matrices. In each of the following parts determine whether the transformation is linear.<br>**(i)** $T_1(A) = A^T$<br>**(ii)** $T_2(A) = \det(A)$ | 1 | 2+1.5+1.5 |
| **Q2** | Using the method of Lagrange multipliers, find the greatest and smallest values that the function $xy$ takes on the ellipse $\frac{x^2}{8} + \frac{y^2}{2} = 1$. | 3 | 5 |
| **Q3** | **(a)** Write Stochastic Gradient Descent algorithm.<br><br>**(b)** Mention three differences between Gradient Descent and Stochastic Gradient Descent algorithms.<br><br>**(c)** What happens if the learning rate is too high or too low? | 4 | 2+2+1 |
| **Q4** | Using the Gradient Descent algorithm to minimize the loss function $f(x, y) = x^3 + 3y^2$ taking a learning rate of 0.2. Execute up to 2 iterations. | 4 | 5 |

<table>
<tr><td>Q5</td><td>(a) Describe soft margin support vector machine as an optimization problem.<br><br>(b) Mention one major difference between hard and soft margin support vector machine classifiers.<br><br>(c) Explain the significance of the regularization parameter.</td><td>5</td><td>3+1+1</td></tr>
<tr><td>Q6</td><td>Compute the first principal components for the following data:<br><table><tr><td>Features</td><td>Example 1</td><td>Example 2</td><td>Example 3</td><td>Example 4</td></tr><tr><td>$X_1$</td><td>4</td><td>8</td><td>13</td><td>7</td></tr><tr><td>$X_2$</td><td>11</td><td>4</td><td>5</td><td>14</td></tr></table>Given that eigenvalues are 6.61 and 30.38, and normalized eigenvectors are $\begin{bmatrix}0.83\\0.56\end{bmatrix}$ and $\begin{bmatrix}0.56\\-0.83\end{bmatrix}$ respectively.</td><td>5</td><td>5</td></tr>
<tr><td>Q7</td><td>(a) What is a sigmoid function in logistic regression? Draw a diagram to illustrate.<br><br>(b) Explain the meaning of log(odds) in logistic regression.<br><br>(c) If a logistic regression model is given by. $\log(odds) = -75.5 + 3 \times input$, then, find the input corresponding to a 95% chance for success.</td><td>5</td><td>1+1+3</td></tr>
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